Unit 1 SELF QUIZ

Write numbers 1 to 12 in your notebook. Indicate beside each number whether the corresponding statement is true (T) or false (F). If it is false, write a corrected version.

For questions 1 to 6, consider a ball of mass m, thrown at an angle above the horizontal and undergoing projectile motion under negligible air resistance.

1. The time for the ball to rise equals the time for the ball to fall to the same horizontal level.
2. The net force on the ball at the top of its flight is zero.
3. The acceleration of the ball on the way up equals the acceleration on the way down.
4. After leaving your hand and before landing, the speed of the ball is at a minimum at the top of its trajectory.
5. The magnitude of the horizontal component of the velocity of the ball just before impact exceeds the magnitude of the horizontal component of the velocity just after the ball leaves your hand.
6. The magnitude of the acceleration of the ball at the top of its trajectory equals the ratio of the weight of the ball to its mass.

For questions 7 to 12, assume that you are twirling a small rubber stopper of mass m (at a constant speed v) tied to a string in a vertical circle as shown in **Figure 1**.

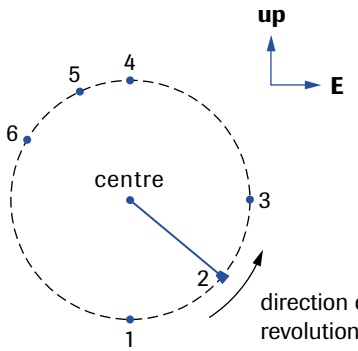

Figure 1
For questions 7 to 12

7. At position 3, the direction of the instantaneous acceleration is westward and the direction of the instantaneous velocity is upward.
8. The vector quantity $\frac{\Delta \vec{v}}{\Delta t}$ is closest to the instantaneous acceleration as the stopper moves from position 6 to position 1.
9. The magnitude of the tension in the string at position 1 exceeds the magnitude of the tension at position 4 by an amount equal to mg.
10. At position 5, the force that causes the stopper to accelerate toward the centre of the circle is the sum of the force of tension in the string and a component of the force of gravity on the stopper.
11. If you release the ball at the instant it reaches position 1, the instantaneous velocity of the stopper just after the release will have a small upward component and a large eastward component.
12. For a constant radius and frequency of revolution of the stopper, the magnitude of the centripetal acceleration is directly proportional to m.

Write numbers 13 to 24 in your notebook. Beside each number, write the letter corresponding to the best choice.

Questions 13 to 18 relate to the situation in **Figure 2**, in which a child on a toboggan (a system of total mass m) accelerates down a hill of length L inclined at an angle θ to the horizontal in a time interval Δt. The $+x$ and $+y$ directions are labelled on the diagram. Assume that friction is negligible unless indicated.

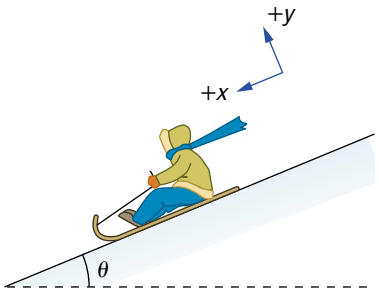

Figure 2
For questions 13 to 18

13. The magnitude of the child's acceleration down the hill is
    (a) $\frac{g}{\sin\theta}$ (c) $g\sin\theta$ (e) $g\tan\theta$
    (b) $\frac{g}{\cos\theta}$ (d) $g\cos\theta$
14. The magnitude of the child's average velocity is
    (a) $\sqrt{2gL}$ (c) $\sqrt{2gL\sin\theta}$ (e) $\sqrt{\frac{gL\sin\theta}{2}}$
    (b) $\sqrt{\frac{gL}{2}}$ (d) $\sqrt{gL\sin\theta}$
15. The magnitude of the force exerted by the toboggan on the hill is
    (a) mg (c) $mg\sin\theta$ (e) $-mg\sin\theta$
    (b) $mg\cos\theta$ (d) $mg\tan\theta$
16. If the child starts from rest and accelerates uniformly down the hill, the time required to reach the bottom of the hill is
    (a) $Lg\sin\theta$ (c) $\sqrt{2Lg\sin\theta}$ (e) $\sqrt{\frac{2L}{g\sin\theta}}$
    (b) $2Lg\sin\theta$ (d) $\frac{2L}{g\sin\theta}$

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17. If $\vec{v}_{av}$ is the average velocity and $\vec{v}$ is the instantaneous velocity, then at the halfway point in the journey down the hill
    (a) $|\vec{v}_{av}| = |\vec{v}|$
    (b) $|\vec{v}_{av}| > |\vec{v}|$
    (c) $|\vec{v}_{av}| < |\vec{v}|$
    (d) $|\vec{v}_{av}|$ and $|\vec{v}|$ can be compared only if we are given numerical data.
    (e) $\vec{v}_{av}$ and $\vec{v}$ cannot be meaningfully compared, since the object in question is on an inclined plane .

18. If the situation in **Figure 2** is changed so that there is a coefficient of kinetic friction μ_K between the toboggan and the hill, then the magnitude of the child's acceleration down the hill is
    (a) $g(\sin\theta - \mu_K \cos\theta)$
    (b) $g(\sin\theta + \mu_K \cos\theta)$
    (c) $\dfrac{g\sin\theta}{\mu_K \cos\theta}$
    (d) $g(\mu_K \cos\theta - \sin\theta)$
    (e) none of these

19. A car of mass m collides head-on with a truck of mass $5m$. If $\vec{F}_{C\to T}$ and $\vec{F}_{T\to C}$ are the forces respectively exerted during the collision on the car by the truck and on the truck by the car, then
    (a) $|\vec{F}_{T\to C}| > |\vec{F}_{C\to T}|$
    (b) $|\vec{F}_{T\to C}| < |\vec{F}_{C\to T}|$
    (c) $|\vec{F}_{T\to C}| = |\vec{F}_{C\to T}|$
    (d) $|\vec{F}_{T\to C}| = 0$
    (e) $\vec{F}_{C\to T}$ and $\vec{F}_{T\to C}$ cancel because they are in opposite directions

20. A monkey throws a walnut from a tree, giving the walnut an initial velocity of 2.5 m/s [down]. Air resistance is negligible. After being released, the walnut experiences an acceleration of
    (a) 9.8 m/s^2 [up]
    (b) 9.8 m/s^2 [down]
    (c) less than 9.8 m/s^2 [down]
    (d) more than 9.8 m/s^2 [down]
    (e) zero

21. A rocket of mass m is at a distance $3r_E$ from Earth's centre when its engines are fired to move it to a distance $6r_E$ from Earth's centre. Upon reaching its destination, its new mass is $\dfrac{m}{2}$ since fuel is consumed in the burn. The ratio of Earth's gravitational force on the rocket at the first location to the gravitational force on the rocket at the second location is
    (a) 8:1 (b) 4:1 (c) 2:1 (d) 1:4 (e) 1:8

22. Which of the following is a list of all the forces that act on a satellite in circular orbit around Earth?
    (a) the force due to the satellite's motion and the force of gravity toward Earth
    (b) the force due to the satellite's motion, the centrifugal force, and the force of gravity toward Earth
    (c) the centrifugal force and the force of gravity toward Earth
    (d) the centripetal force and the force of gravity toward Earth
    (e) the force of gravity toward Earth

23. A stunt airplane flies in a vertical circular loop of radius r at a constant speed. When the airplane is at the top of the loop, the pilot experiences an apparent weight of zero. The speed of the airplane is
    (a) $2gr$ (c) $\dfrac{g}{r}$ (e) $\sqrt{\dfrac{g}{r}}$
    (b) gr (d) $\sqrt{gr}$

24. A 9.5-kg box is initially stationary on a horizontal table. The coefficient of kinetic friction between the table and the box is 0.49. The coefficient of static friction is 0.65. The magnitude of the minimum force needed to set the box into motion is
    (a) 4.7 N (c) 93 N (e) 46 N
    (b) 6.2 N (d) 61 N

Write the numbers 25 to 40 in your notebook. Beside each number, place the word, number, phrase, or equation that completes the sentence(s).

25. State the number of significant digits in each measurement or answer of the operation:
    (a) 0.0501 N __?__
    (b) 3.00×10^5 km/s __?__
    (c) 25.989 m + 25.98 m + 25.9 m + 25 m __?__
    (d) 65.98 m ÷ 11.5 s ÷ 2.0 s __?__

26. Convert the following measurements:
    (a) 109 km/h = __?__ m/s
    (b) 7.16×10^4 km/min = __?__ m/s
    (c) 3.4 mm/s^2 = __?__ m/s^2
    (d) 5.7 cm/(ms)^2 = __?__ m/s^2
    (e) 4.62×10^{-3} (km/h)/s = __?__ m/s^2

27. A windsock indicates __?__.

28. The three principal controls a car has for regulating acceleration are __?__, __?__, and __?__.

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29. You are facing southward when suddenly a snowball passes in front of your eyes from left to right. The snowball was thrown from some distance away with an initial horizontal velocity. The direction of the instantaneous velocity is now ___?___. The direction of the instantaneous acceleration is now ___?___.
30. If the direction of an object undergoing uniform circular motion is suddenly reversed, the direction of the centripetal acceleration is ___?___.
31. If $\vec{v}_{LM}$ is 26 m/s [71° W of S], then $\vec{v}_{ML}$ is ___?___.
32. ___?___ $= \vec{v}_{CD} + \vec{v}_{DE}$
33. The horizontal acceleration of a projectile is ___?___.
34. The acceleration of an object falling (vertically) through the air at terminal speed is ___?___.
35. Using L, M, and T for the dimensions of length, mass, and time, respectively, then
    (a) the dimensions of the slope of a line on a velocity-time graph are ___?___
    (b) the dimensions of the area under the line on an acceleration-time graph are ___?___
    (c) the dimensions of weight are ___?___
    (d) the dimensions of the universal gravitation constant are ___?___
    (e) the dimensions of gravitational field strength are ___?___
    (f) the dimensions of a coefficient of static friction are ___?___
    (g) the dimensions of frequency are ___?___
    (h) the dimensions of the slope of a line on an acceleration-force graph are ___?___
36. The law of inertia is also known as ___?___.
37. As the speed of a flowing river increases, the pressure of the flowing water ___?___.
38. An accelerating frame of reference is also known as ___?___. In such a frame, we must invent ___?___ to explain an observed acceleration. If the frame is rotating, the invented force is called ___?___.
39. A passenger of mass *m* is standing on an elevator that has an acceleration of magnitude *a*. The normal force acting on the passenger has a magnitude of ___?___ if the acceleration is upward, and ___?___ if the acceleration is downward.
40. On the surface of the Moon, your ___?___ would be the same as on the surface of Earth, but your ___?___ would be reduced by a factor of ___?___.

Write the numbers 41 to 46 in your notebook. Beside each number, place the letter that matches the best choice. Use the choices listed below.

(a) directly proportional to
(b) inversely proportional to
(c) proportional to the square of
(d) inversely proportional to the square of
(e) proportional to the square root of
(f) inversely proportional to the square root of
(g) independent of

41. For an object moving at a constant velocity, the time interval needed to cover a certain displacement is ___?___ the velocity.
42. When a ball is undergoing projectile motion, the horizontal motion is ___?___ the vertical motion.
43. For a car that starts from rest and undergoes constant acceleration, the time interval to cover a certain displacement is ___?___ the displacement.
44. On the surface of Earth, your weight is ___?___ the mass of Earth.
45. For an object that remains stationary on a horizontal surface, the magnitude of the static friction is ___?___ the magnitude of the horizontal force applied to the object.
46. For an object undergoing uniform circular motion with a constant radius, the magnitude of the centripetal acceleration is ___?___ the speed. The force that causes the centripetal acceleration is ___?___ the period of revolution of the object.

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